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## Implementation of Lean Six Sigma in Saudi Arabian Organisations: Findings from a Survey

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Abstract

**Purpose:** Although the popularity of the Lean Six Sigma methodology has illustrated many benefits over the years for those organisations who have implemented it, this strategy has received less attention in developing countries. The aim of this paper is to critically assess the current status of Lean Six Sigma implementation in Saudi Arabian organisations.

**Design/methodology/approach:** This research is based on a descriptive survey questionnaire which has been derived from two systematic literature reviews. The survey was distributed to 400 organisations in Saudi Arabia using Qualtrics online software. 146 responses were received where 102 responses were completed and analysed.

**Findings:** The findings of the survey highlighted that the implementation of LSS is still in the early stages in organisations within Saudi Arabia. This was clearly shown by many factors such as years of deploying LSS, LSS infrastructure, level of awareness of LSS, impact of LSS on business functions and so on.

**Originality/value:** This paper contributes to the current status of LSS in Saudi Arabian organisations. It also gives recommendations to guide the future of LSS in Saudi organisations by comparing to LSS literature and best practice.

**Research Limitations:** The primary limitation of this study is that data has been collected from an online survey and therefore no deeper insights could have been captured from the survey. This limitation will be rectified by executing semi-structured interviews in selective organizations within Saudi Arabia.

**Keywords:** Lean Six Sigma, Saudi Arabia, Developing countries, Current Status, Survey

**Paper type:** Research Paper

1. Introduction

Lean Six Sigma (LSS) is the latest continuous improvement (CI) methodology (Wang and Chen, 2010) that has proved to be successful in numerous organisations around the globe. Lean Six Sigma is a combination and synergy between two powerful CI methodologies; Lean management and Six Sigma methodology (Vinodh et al., 2012; Kumar et al., 2006; Hilton and Sohal, 2012).

LSS is defined by Snee (2010, p.10) as “a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom line results.” LSS methodology aims to improve capability in an organisation, reduce production costs (Lee and Wei, 2009; Chen and Lyu, 2009) and maximise the value for shareholders by improving quality (Antony et al., 2003; Laureani and Antony, 2012). According to Albliwi et al. (2015) most of the organisations implement LSS strategy in the current time to improve their business performance and operational efficiency, especially in the growth of global markets (Maleyeff, 2012; Jayaraman et al., 2012). Other reasons are to improve product quality (Vinodh et al., 2012), reduce production costs and to enhance customer satisfaction

(Chen and Lyu, 2009; Snee, 2010). It has been argued that LSS is a powerful strategy for process management and process excellence aims to eliminate defects and reduce variation in the process of service and product manufacturing, leading to business process excellence (Snee, 2010).

Although LSS has been deployed in many Western organizations for more than a decade, its implementation and popularity in the Middle Eastern countries such as Saudi Arabia remains in the early stages. There is also a dearth of empirical research that presents the current status of LSS in many eastern countries. Hence, the purpose of this paper is to empirically assess the current status of LSS implementation in a Middle Eastern country; Saudi Arabia. This research has investigated LSS from many angles using survey questionnaire instrument.

In order to achieve the overall research aim, the study attempts to shed some light on the following question:

*What is the current status of Lean Six Sigma implementation in Saudi Arabian organisations?*

In order to answer the research question, it is important to understand the concept of Lean Six Sigma in general and briefly review the LSS literature. The following section will do so.

## 2. Literature Review of Lean Six Sigma in Saudi Arabian Organisations

Investigating the history of quality practices and continuous improvement in Saudi Arabian organisations shows that ISO 9000, ISO 9001, ISO 14001 and TQM have been adopted broadly by Saudi private and public organisations (Alsaleh, 2007; Magd, 2006). Many research studies have conducted to investigate the status of quality practices in general in Saudi Arabia such as Al-Darrab et al., (2013) and Al Rubaish, (2010). Other research has focused on international standards for quality such as ISO series (Magd, 2006; Mariottia et al., 2014; Curry and Kadasah, 2002) and CI methods including TQM (Alsaleh, 2007; Curry and Kadasah, 2002; Al-Sulimani, 1995), Six Sigma (Alsmadi et al., 2012; Ateekh-ur-Rehman, 2012), Lean (Abdelhadi and Shakoor, 2014; Abdelhadi, 2014), Lean and Taguchi (Noorwalia, 2013) and many others. However, the researchers observed that there is a dearth of empirical studies on the use of LSS within Saudi Arabian organizations which will be the focus of this research paper. However some case studies have been published on LSS in healthcare sector within Saudi Arabian context. The first study was conducted in a public health care centre to reduce waiting time in vaccination room from 24.5 minutes to less than 10 minutes using tools and techniques from Lean Six Sigma tools box (El Faiomy and Shabana, 2012). Another case study was carried out to improve patient flow in emergency departments (Al Owad et al., 2013). Reddy and Al Shammari (2013) reported an interesting case study to streamline the current discharge process of King Khalid hospital. In addition, two case studies were published on LSS implementation in the construction sector. The first case presented the implementation of Lean, Green and Six Sigma framework in the construction sector (Banawi and Bilec, 2014). The second case was published by Bechtel construction, which was seeking time reduction for building 405 villas for community in Jubail Industrial City in Saudi Arabia (Kim et al., 2012).

Oil, gas and petrochemicals industry has the highest number of publication with 4 case

studies published by a leading petroleum organisation “Saudi Aramco” and King Fahad University of Petroleum & Minerals (Bubshait and Al-Dosary, 2014; Amminudin et al., 2011; Al-Sadat and Robertson, 2007; Dhafer, 2014). Furthermore, a LSS study was conducted in the media and entertainment sector in Saudi broadcasting corporative in Riyadh to increase the employees’ safety by decreasing accidents from 25 to 7 accidents a year (Alharthi et al., 2014). In higher education sector, King Abdullah University of Science and Technology (KAUST) are progressing at an advanced level in LSS deployment since 2009. However, LSS projects in KAUST have not been published with the exception a conference paper presented in 2012 in Scotland. It was interesting to observe that a LSS PhD project was carried out by Almuharib (2014) in King Khalid International airport in Riyadh to enhance the level of service and customer satisfaction in the departure area. One of the tangible results of this project was a total reduction in passengers waiting time from 54.74 minutes to 34.87 minutes.

Table1

Unfortunately, there is a dearth of evidence in LSS implementation and publication in the Saudi Arabian context in general and in most of the sectors in the country. This includes the airline industry, the banking sector, the insurance and financial services, the education sector, the police force, general manufacturing and others. This defiantly shows the need for more research to be undertaken to understand and present the current status of LSS implementation in Saudi Arabia. The first and the only research that investigated the Six Sigma phenomena in 100 Saudi Arabian organisations was undertaken in 2012 using a survey questionnaire instrument (Alsmadi et al., 2012). However, this research was primarily focused on Six Sigma and not LSS. Hence, it is critical to investigate the current status of LSS implementation in terms of the level of training and coaching, motivation factors, culture effect, critical success factors, benefits and so on as presented in the following section.

3. Research methodology

In order to evaluate the current status of LSS within Saudi Arabian organizations, the authors have decided to pursue an online survey. After reviewing the different types of survey methods, descriptive survey was undertaken (Forza, 2009). This method is the only applicable way to describe the current level of Lean Six Sigma implementation in Saudi Arabian organisations (Forza, 2009; Saunders et al., 2009). Descriptive survey with closed questions (to understand background information about the participating organisation, status of Lean/Six Sigma projects, training and so on) and multiple – choice questions (to determine Critical Success Factors (CSFs), benefits, enablers and inhibitors, challenges, factors of motivation and so on) were introduced in the survey and allowed the respondents to tick as many boxes as applicable. In addition, the category ‘Don’t know’ or ‘other’ was added to allow the respondents to answer in their own words (Forza, 2009). Likert scale (one of the more frequently used types of scales) was used in the survey to allow participants to give more discriminating responses and to state if they have no

opinion (Easterby-Smith et al., 2012; Collis and Hussey, 2003). The reason behind the choice of this scale was because it is simple for respondent to complete and simple for the researcher to code and analyse (Collis and Hussey, 2013).

The survey questions were derived from two systematic literature reviews undertaken by Albliwi et al. (2014) and Albliwi et al. (2015), both published in peer reviewed journals within the field of operations management and LSS. The survey questions were piloted with 10 leading academics and practitioners in the field to test the questions clarity and relation to the main research questions. Brainstorming technique was also applied with numerous professionals in the field of continuous improvement and LSS during an International Conference on LSS organized and chaired by one of the co-authors to develop valuable questions.

### 3.1 Sampling method and procedure

Identifying the target population and selecting sample is recognised as the most critical stage of survey research because the quality of the sample determines the generalisability of the results (Gay and Diehl, 1992; Collis and Hussey, 2003). For the purpose of this research, the authors have used systematic random sampling to target Saudi organisations that have been implementing Lean or/and Six Sigma for at least a year.

A set of criteria was developed by the researchers in order to ensure that the correct sample of organisations were selected (Eisenhardt, 1989; Yin, 1994; Voss, 2009). Hence, the sample selection was based on the following criteria:

1. Organisations located in Saudi Arabia (private and public, large and SMEs, any industry)
2. Deploying Lean/Six Sigma or both for at least 1 year
3. Having a valid phone number, email address, and website

### 3.2 Survey design

In order to assess the current status of LSS in any organisation, it is important to investigate many issues including (Chakrabarty and Chuan Tan, 2007; Antony and Desai, 2009; Nonthaleerak and Hendry, 2008; Antony and Banuelas, 2002; Alsmadia et al., 2012; Antony et al., 2005):

- A. Years of deploying Lean, Six Sigma, LSS
- B. LSS infrastructure
- C. Level of awareness of LSS
- D. LSS methodologies (DMAIC, DMADOV, IDOV, etc.)
- E. Impact of LSS on business functions
- F. LSS training
- G. Benefits gained from LSS implementation
- H. Motivational factors for LSS deployment
- I. Organisational learning
- J. Critical Success Factors for LSS
- K. Common challenges for LSS implementation
- L. Tools and techniques of LSS



The survey was designed to consist of two parts, the first part of the survey aimed to gain general information about the participating organizations such as the organisation's background including start-up year, organisation size, turnover, number of employees, number of employees who are holding Lean Six Sigma belts, history of other quality management/improvement practices and so on.

The second part of the survey aimed to find out more about the nature of Lean and Six Sigma implementation in the business including aspects such as motivation factors for implementing Lean/Six Sigma, benefits gained, challenges for the implementation of Lean/Six Sigma, organisational learning level, cultural effect and more others.

3.3 Survey distribution

The survey has been distributed to 400 organisations in Saudi Arabia using their emails addresses which were available online and in "The Council of Saudi Chambers" database. The researchers have contacted the Lean/Six Sigma deployment facilitator in the most appropriate organisations and asked them to participate in the survey. They were informed that the questionnaire is targeting specific people such as CI initiatives practitioners, managers, practitioners work in quality department, Lean/Six Sigma team members etc. (who have deep knowledge in Lean and Six Sigma methodology). Then the contacted person in each organisation was asked to nominate the people who meet the sample selection criteria. Those people then were contacted through phone and emails and they were asked fill up the survey and forward the link to other Lean/Six Sigma team members, managers involved in Lean/Six Sigma projects or training in their organisations.

3.4 Response Rate

Although there is no minimum response rate has agreed, before the year 2000, the top journals in the field of operations management have stated that the response rate varies from 20-40% (Frohlich, 2002). Other scholars in operation management suggested that the response rate should be 50% in minimum (Forza, 2009). Easterby-Smith et al., (2012) argued that 20% response rate has considered as sufficient by many researchers. Searching the literature for the sufficient sample size in Lean and Six Sigma research shows that even around 10% response rate is acceptable e.g. Shah et al., (2008) had 8.9% survey sample size. This view has supported by Collis and Hussey, 2013 who argued that researchers using questioner technique should expect response rate of 10% or less.

Since this research was targeting Saudi organisations that have implemented Lean and /or Six Sigma as a strategy to improve their business, a low response rate was expected as this methodology is very advanced and may not be found in developing countries such as Saudi Arabia according to literature. However, from 400 distributed survey, the researchers received 146 responses where 102 were completed and 44 responses were excluded from the analysis as they were incomplete. The total response rate was 25.5% which is considered as high (Forza, 2009).

4. Survey results and analysis

By analyzing both parts of the survey, the researchers have built a clear picture for the nature of LSS implementation in the participated organisations. In addition, this will guide the

following stage of data collection in the future work will involve a case study with semi-structured interviews.

#### 4.1 Demographic Information

The first part of the survey was dedicated to gathering information of the diverse sectors in which the participants operate, varying greatly from private to public, and including: Manufacturing (23%), higher education (20%), oil and petrochemicals (20%), food and drugs (11%), banking (8%), harbour services (3%), airlines (2%), city councils (2%), construction (2%), engineering (2%), internet solution services (2%), public development authorities (3%) and training services (2%). The year of establishment of these organisations also covered a large span, between 1930 and 2013, which contributes to the richness of the results.

With regards to the number of employees in each organisation, only 10% of respondents worked in organisations with less than 500 employees (not SMEs); the rest worked in large organisations with over a thousand employees.

In addition to the size of the organisation, participants were asked about their organisations annual turnover and the results are showed in figure 1.

Figure 1

The figure above illustrates that most of the organisations from the study have a turnover above \$50M. Revenue could be considered a factor influencing the investment on CI initiatives and; therefore, a point of consideration for the analysis of the survey results is whether differences exist between organisations with high, low and zero turnover, such as public institutions.

The sample of respondents to the survey included people from different areas and hierarchies within the organisation: business excellence, customer service, engineering, IT, production, project management, quality and; CEOs, senior managers, mid-level managers, staff and the LSS teams. Details of the participant's positions are presented in Table 2.

Table 2

Focusing on LSS certified participants only, around 81% of the respondents hold LSS belts including 5 Champions, 5 MBBs, 22 BBs, 34 GBs and 13 YBs. The rest of the respondents were either in training (9) or quality managers (8) who have not received LSS so far. Some of the respondents (6) preferred to keep their training confidential.

#### 4.2. History of Quality Practices

The respondents were asked whether a quality department exists in their organisations; 72.5% answered yes and 27.5% answered no. This insight is a valuable start point to differentiate CI initiatives between different organisations as it distinguishes the approach to the selection and implementation of the CI initiatives amongst both groups.



4.2.1. History of CI Methodologies

Historically, the approach to continuous improvement within a third of these organisations has entailed the adoption of Lean and Six Sigma programmes without deploying any previous CI initiatives, as shown in table 3.

Table 3

The other two thirds indicated that they used TQM, Kaizen or both as the foundation for their Lean and Six Sigma programme. This finding could lead to the conclusion that TQM and Kaizen are well recognised by many Saudi Arabian organisations, particularly those in the private sector. Notwithstanding the recognition of these techniques and the interest of managers in using new forms of quality tools (Alsaleh, 2007), the literature indicates that the implementation of TQM has faced many obstacles in Saudi Arabia such as the lack of a well-defined process, the lack of effective communication, the diversity of the customers, etc. (AL-Shafei et al., 2015).

Table 3 also shows that private sector organisations are more familiar to CI practices than their counterparts in the public sector. There are a number of reasons for this phenomenon, like the nature and policy within each sector or whether the person championing change is a leader or a manager. On the one hand, a clear example of the former is the perception of job security. While in the public sector being made redundant for poor performance evaluations is highly unlikely, in the private sector job safety greatly depends on performance and customer satisfaction. On the other hand, the duality between managers and leaders also seems sector dependent, as leaders are more likely to drive change in private organisations while managers are more dominant in public organisations (Drummond and Al-Anazi, 1997; Al-Qhatine, and Al-Methheb, 1999).

Complementary to the historical approach to CI methodologies, the participants were questioned about the use of other business process improvement methodologies such as Business Process Management (BPM), Theory of Constraints (TOC) and Business Process Reengineering (BPR)

Table 4 shows that the above practices were more common amongst the oil and chemical industries than in other sectors. Regardless of the size of the organisation, BPM and BPR were used in a quarter of organisations from the sample. Furthermore, 6% of the participants (particularly those whose parent companies were based in western countries) used methodologies internal to their organisation in addition to those afore mentioned.

Table 4

For some authors like Breyfogle (2003) there are clear benefits to the integration of ISO standards with LSS. This view appears to be shared by most organisations in the study, who implemented ISO 9001 as a starting point for other continuous improvement methodologies such as TQM and LSS. Approximately one third of the organisations used ISO 9001 as a quality management system standard; additionally, half of the participants implemented other ISO standards to reduce the environmental impact (ISO 14001), for Six Sigma (ISO 13053)

and, for health and safety in the work place (OHSAS 18001). The latter commonly applied in the manufacturing and oil industries in Saudi Arabia.

From the organisations within the public sector in the sample, 15% started to deploy LSS without ISO certifications as a basis for CI. In contrast, only one organisation implemented multiple ISO standards, including the ISO 50001 for energy saving, following the practices of their parent organisation in France.

Table 5

ISO in all its different versions appears popular in Saudi Arabian organisations, being well recognised by both public and private organisations alike. Data from an ISO survey shows the rising interest on ISO standards since the number of Saudi Arabian certified organisations has increased from 10 in 1993 to 2189 in 2012. Yet, this figure is small in comparison to the circa 76,775 organisations registered in the country, according to the last survey from ministry of commerce and industry in 2012; meaning that only 3% of Saudi Arabian organisations are ISO 9001 certified.

The successful implementation of CI initiatives could lead to achieving quality awards such as the Malcolm Baldrige National Quality Award or the Business Excellence Award (Snee, 2010; Harry and Schroeder 2000; Barney, 2002; Taghizadegan, 2006; Breyfogle, 2003). It was, thus, essential to explore if any of the participants has experienced award winning in their organisations as a result of CI deployment. The participants were asked whether their organisations had won any local awards, such as King Abdulaziz Quality Award (KAQA); or international awards like the Business Excellence Award European Foundation Quality Management (EFQM), Malcolm Baldrige National Quality Award (MBNQA), Deming Prize or any other. The results in figure 2 show that one fifth of the organisations have won a local award KAQA and another 21% have won EFQM award. These results indicate that in spite of having CI practices in place, some organisations are yet to achieve the level of quality required to receive an award.

Figure 2

#### *4.3. Lean Six Sigma practices in the participating organisations*

This section of the paper addresses the research question and investigates the issues related to LSS practices.

##### *A. Years of deploying Lean, Six Sigma and LSS*

The longest times of implementation were 12 years for Six Sigma in a manufacturing organisation and 10 years for Lean in an oil producing organisation; both of which are large organisations and have joint venture with foreign partners leading the initiative. Almost a third of the organisations reported to have implemented Lean for a number of years

(between 1 and 10) before adopting Six Sigma to support it. In contrast, 10% of the organisations—all in the private sector—implemented Six Sigma for a number of years before adopting Lean. An additional 25% of the organisations—14% public and 11% private—implemented LSS as one approach. The remaining 35% of organisations deployed Lean (1-6 years) or Six Sigma (1-3 years) in isolation.

***B. Number of people trained for LSS belts (infrastructure)***

According to Harry and Schroeder (2000), Six Sigma training should be delivered to at least 50% of the organisation’s staff in order to drive change in the business and increase profits. In spite of the participants coinciding with the authors that training and coaching are critical to LSS success, the proportion of trained individuals in the sample is much lower than that reported in the literature and western organisations. The next sections present the insights of the training for each particular qualification within the sample.

***a. Number of Champions:***

It was observed that the vast majority—74%—of the organisations, regardless of their size, counted with only between 1 and 5 champions; and, an additional 5% had between 6 and 10 champions (5,100-10,000 employees). Only 2% had more than fifteen champions, where all were large organisations with above ten thousand employees; and nearly a fifth reported that there were no LSS project champions in their organisations. This last finding contrasts with the information reported in literature where it is stated that the champion could be the CEO or the vice-president of the organisation; individuals who have the knowledge to lead the initiative. Examples of this are corporations like GE, Honeywell or Motorola. (Antony and Banuelas, 2002).

***b. Number of MBB:***

Similar to the number of champions in the organisation, the number of certified MBBs in Saudi Arabian organisations is lower than reported in literature and belt theory, which provides as a target having one MBB for every hundred BB (Harry, 1998). A large proportion of the sample—43%—reported that a LSS MBB representative was not available in their organisations. An additional 44% reported having between 1 and 5 MBBs in their organisations, which varied in size between three hundred and ten thousand employees. There were 6-10 MBBs in an additional 8% of the sample comprising organisations between 5,100 and 10,000 employees; and, a final 5% indicated having 15 MBBs in their organisation, averaging in size to above 10,000 employees.

***c. Number of BB:***

Literature suggests that the ideal ratio of BBs is 1 BB for every 100 employees (Harry, 1998; Breyfogle, 2003; Karthi et al, 2011). This could enable the organisation to reach 6% cost reduction per year (Harry, 1998).

In this sample, 69% of participants indicated that within their organisations less than 1% of employees were trained as BB. An additional 9% of the participants disclosed that there are

no trained BB employees within their organisations and that the projects and initiatives are carried out by external GB or YB consultants where available. In contrast, 22% of the organisations have more than 2% of the employees trained as BB in their organisations, which is in line the recommendations found in literature.

Further investigating the ratio of Black Belts to the total number of employees in the sample, it was found that 18% of the participants had one BB in their organisations for every 50 employees, 26% of the participants had one BB for every 300 employees, 8% of the participants had one BB to every 1000 employees and the remaining of the participants had either one, two or no BBs in their organisations. From the latter, some stated that their organisations were in the process of building their LSS infrastructure and BBs were still in the training stages; and a small proportion of the organisations stated that they have little adoption of LSS as *ad-hoc* projects hence they don't employ full-time LSS Black Belts yet.

An additional consideration to factor in is the proportion of employees that left the sponsoring organisation after receiving LSS training. From the sample, 10% of participants stated that trained employees had abandoned the organisation upon completion of their training, which represented a big loss for the sponsor organisation. The reasons behind this phenomenon have not been the focus of this research, thus further work is required to understand the motivating factors for employees leaving and whether the sponsor organisations should receive compensation for the training investment.

It was observed from the survey that about 10% of the participating organisations did not have either Black Belts or MBBs. This clearly shows that there is no formal LSS organisational infrastructure in place for sustaining the initiative.

*d. Number of GB:*

For the case of GBs the literature suggests that there should be 20 GBs per each BB (Harry and Schroder, 2005; Karthi et al, 2011) or 5 GBs per 100 employees in the organisation (Hoerl, 2001). Some scholars even suggest that all middle managers should be trained for GB and everyone should be trained for GB to get promoted (Hoerl, 2001).

Within the sample 73% of the participants indicated that less than 15% of the employees in their organisation had trained for GB; and only 5% of respondents indicated that they have around 60% GB in their organisation; all of which belong to a large organisation with more than ten thousand employees.

*e. Number of YB:*

Following the trend already observed, the participants indicated that 90% of the participants have less than 15% employees have certified as YB and the rest have less than 30%. These results indicate that YB training is not a priority for Saudi organisations in spite of the fact that the literature suggests that all employees should attend awareness sessions and preferably be YB certified to contribute in changing the organisational culture (Gupta, 2005).

In general terms, it was observed that Saudi Arabian organisations lack trained employees; more so in public and local organisations than in multinational corporations, where the recommended numbers of LSS belts were available.

C. *Level of Awareness about LSS*

As important as it is to have the right qualified people in the organisation is the level of awareness about LSS. For this study, the awareness in Saudi Arabian organisations was evaluated in two levels: practitioner’s awareness and organisation’s awareness. It is worth clarifying that the level of awareness of LSS could be different to the level of implementation. For example, a participant could rate themselves as fully aware about LSS, meaning that they have knowledge of or experience in LSS; however, that does not necessary reflect the level of LSS implementation within the organisation they work for. In this study, the Likert scale was used to test the two levels of awareness using a 5-stage technique rating from 1 = not aware to 5 = fully aware. The results were as follows:

1. *Participants' awareness*

Half of the respondents were found to be fully aware about Lean/Six Sigma, 24% were well aware, 17% were somewhat aware and 9% had limited awareness. This clearly shows that all respondents had some knowledge of LSS and ensures that the entire sample can understand the survey questionnaire well enough to provide suitable answers the questions, preventing deviations or inconsistencies due to lack of knowledge or misunderstanding of concepts.

2. *Organisations' awareness*

From the respondents’ perspective most organisations (44%) were described as somewhat aware about LSS. A further 11% said their organisations had limited awareness in comparison to the 33% that stated their organisations were well aware of LSS or the 11% who expressed that their organisations were fully aware of LSS. Only 1% of the participants described their organisations as not aware about LSS.

It was interesting to find that some organisations with little awareness of LSS counted with GBs and BBs amongst their employees. This sight was further investigated in the interview phase presented in Chapter 5 but the hypothesis is that they were hired to create awareness and support the deployment of LSS.

Figure 3

D. *LSS Methodologies*

There are several methodologies for the implementation of LSS in an existing system, such as DMAIC (Define, Measure, Analyse, Improve, Control), or PDCA (Plan, Do, Check, Act) and; other methodologies for Design For Six Sigma (DFSS) which include DMADOV (Define, Measure, Analyse, Design, Optimise, Verify) and IDOV (Identify, Design, Optimise, Validate). The preference of use of any particular methodology over another in the Saudi Arabian organisations in this study is not consistent. One quarter of the organisations use Lean and Six Sigma tools under DMAIC methodology, 11% use PDCA only—without the implementation of the Six Sigma approach, using instead Lean and TQM—and, 49% use both as a framework for problem solving.

Furthermore, 8% of participants used LSS methodologies combined with one DFSS methodology and 2% used the four methodologies at the same time, which is not the standard for LSS deployment. The later could be explained both by a lack of understanding of the use of LSS methods or as a result of failed attempts to use one methodology, thus moving on to the next one.

#### ***E. Impact of LSS on Business Functions***

In spite of the levels of awareness or implementation of LSS, the respondents highlighted some functions within their organisations where operations have improved with the use of this methodology. These are:

- a. Customer service
- b. Administrative processes
- c. Production processes
- d. Supply chain
- e. Information systems

Notwithstanding, other functions such as HR, finance, sales and marketing have also seen the benefits of LSS, only in a lower scale than the above listed.

#### ***F. LSS training and Education***

There are numerous ways in which an employee can obtain knowledge about quality improvement methods, tools and techniques. In the sample for this study one quarter received in-house training while a similar proportion (20%) were sponsored to receive LSS training from external institutions. For the remaining participants LSS knowledge acquisition varied between: independent learning (13%), via internet (10%), conferences and workshops (8%), distance learning (1%) and other learning methods such as postgraduate degrees.

More details about training, including the training provider, hours of training, and the nature of projects will be investigated in the next phase of this research.

#### ***G. Benefits gained from LSS implementation***

The benefits gained from the implementation of LSS in the Saudi Arabian context are shown in table 6. As expected, these benefits are similar to those sighted in the literature related to western countries (Albliwi et al., 2015). However, in contrast to the increased profits and financial savings reported for western countries, increased customer satisfaction was at the top of perceived benefits for Saudi Arabian organisations.

Table 6

The priorities in the implementation of LSS for Saudi Arabian organisations focus more around customer satisfaction, the quality of the products or service and cycle times than on financial benefits and increasing the bottom line. This trend was previously reported in literature by Alsmadi in 2012, although the sample was limited then to 15 organisations.

The evolution of technology and media changed the focus and behaviours of consumers around the world but particularly in Saudi Arabia. The more recent openness to the global



markets, initiated when Saudi Arabia joined the World Trade Organisation (WTO) in 2002, augmented the levels of competition to an international level and, therefore, customers became more demanding of high quality product and service offerings (Al-Maghrabi and Dennis, 2011). To abide with the ever increasing demands and to maintain their strength and presence in the local and international market place Saudi Arabian organisations were motivated to focus on quality and customer satisfaction (Alsmadi et al., 2012).

**H. Motivational Factors for LSS deployment**

The key motivating factors to adopt LSS are different from one organisation to another; nevertheless trends were observed, being the top three factors the need to reduce time (cycle time, lead time, etc.), to improve the quality of the product and process, and to improve process efficiency and effectiveness. Slight differences in priorities between the priorities of Saudi Arabian organisations and those of Western countries were observed. These are presented in table 7.

It is evident from the results that the most common motivating factors and perceived benefits of the implementation of an LSS initiative are to reduce time, improve quality and efficiency, all of which bring overall benefits to the business; still there are some challenges in the implementation process that cannot be explained by misaligned or unmanaged expectations (Albliwi et al., 2014).

Table 7

Beside the motivational factors for organisations to deploy LSS, it is also important to investigate the motivational factors for the people who are involved in LSS projects and implementation. More details will be available in future work, gathered by interviewing more LSS team members to understand their motivation for using LSS as a business process improvement strategy.

**I. Lean Six Sigma Projects and Organisational learning**

Understood as the process of improving action through better knowledge and understanding (Fiol and Lyles, 1985, p. 803) organisational learning (OL) is closely linked to Lean and Six Sigma as independent methodologies (Hines et al., 2004; Schroeder et al., 2008; Savolainen and Haikonen, 2007) but also to LSS as a single approach (Manville et al., 2012; Watson, 2001). Therefore, it was essential for this research to examine the influence of OL on LSS implementation within the Saudi Arabian context.

The participants in the sample were asked to rate the extent to which their organisations encouraged them to learn from each other's experiences, from errors incurred during project implementation, from failed LSS implementation projects or any other sort of learning. The results, as shown in figure 4, indicate that only one third of the organisations definitely have OL practices in place to encourage learning through benchmarking against competitors, analysis of implementation errors, and the identification of areas of opportunity. For the rest of the participants it was unclear whether an OL practice existed (2%), was reinforced (14%) or was clearly identified as an OL practice (51%), which leads to believe that even though learnings could be taken on board, employees are not encouraged to reflect upon the

challenges faced to identify areas of opportunity and actions to prevent those challenges in the future.

Figure 4

### ***J. Critical Success Factors (CSFs)***

The success of an initiative depends greatly on the definition of the criteria to evaluate success or critical success factors (CSFs). The CSFs used in this study were distilled from existing literature (Antony et al., 2003, Snee and Hoerl, 2003, Snee, 2010, Hilton and Sohal, 2012).

The CSFs for LSS implementation within Saudi Arabian organisations were found to be similar to the ones distilled from literature as presented in table 8. Training and coaching, management commitment and support, communication, and project selection and prioritization are the top ranked CSFs.

Table 8

Other factors such as organisational culture, linking LSS to an HR reward system and linking LSS to supply chain performance ranked lower in importance from a Saudi organizations' point of view. Perhaps the most contentious ranking was that of organisational culture, which did not feature as a CSF for LSS implementation within Saudi Arabian organisations in spite of being in among the top 5 CSFs in literature.

The involvement of other departments in the organisation such as HR or IT currently represents one of the greatest challenges in LSS deployment for Saudi organisations. The majority of the participants in the study believe that collaboration between the LSS team and other areas is difficult because it can take months to reach seamless collaboration. The same occurs when linking LSS to supply chain, as this requires full participation and commitment from suppliers to spread LSS within their own business and this can be difficult to accomplish.

### ***K. Common Challenges for LSS implementation***

The top challenges for LSS in Saudi organisations were predominantly centred on implementation times, leadership and awareness of LSS benefits. Interestingly less cited challenges were national regulations, unmanaged expectations and competing projects. These insights are slightly different to the findings in literature, which are depicted in table 9

Table 9

Probably the most contrasting insight between literature and the results of this study is the impact of resources on successful LSS implementations. It appears that in Saudi Arabia financial resources are not an issue nor create obstacles for LSS deployment. Some authors attribute this to the current situation of the country and the lack of economic crisis over the

past years (Drummond and Al-Anazi, 1997); others attribute it to the fact that organisations in Saudi Arabia do not pay taxes to run operations and people who live in Saudi Arabia and other gulf countries do not pay taxes for living nor for public services, unlike other western countries (Taghawi-Nejad, 2015).

*L. Tools and techniques of LSS*

It is stated in literature that integrating statistical and non-statistical tools and techniques within the Six Sigma methodology is recognized as one of the success factors for Six Sigma implementation (Antony and Desai, 2009). Opposite to the findings from literature in developed countries (Albliwi et al., 2015), the results of the survey in this study show that the top five tools and techniques used in Saudi organizations do not include any advanced statistical tools or techniques such as Statistical Process Control (SPC), Design of Experiments (DOE), Robust Design (RD). The most commonly applied were simple statistical tools and techniques as shown in table 10.

Table 10

These findings are aligned with previous research carried out in Saudi Arabia, concluding that in comparison to their western counterparts, Saudi organisations use very traditional tools and techniques for Six Sigma projects such as brainstorming and root cause analysis (Alsmadi et al., 2012).

**5. Discussion**

The results of the survey indicate that there are several aspects of LSS implementation in Saudi Arabian organisations that need to be addressed. In general terms, it was evidenced that there is a lack of awareness about the levels of implementation and success rates of LSS initiatives. Particularly in this sample this is a point for consideration given that most participants held LSS belts and were undertaking CI projects, ergo they were expected to have knowledge of the past and present initiatives within their organisations. This lack of awareness is most likely a result of a lack of communication and inefficient information sharing practices within the organisation.

To present the current status of Lean and/or Six Sigma in the Saudi Arabian organisations in a more understandable manner, the results have been grouped according to the nature of the participating organisations.

*5.1 International organisations*

In this study, 13% of the participants were working in international organisations, all of which refused to share financial information including investment and ROI. Participants from those organisations were well aware of the benefits LSS has brought to their business. LSS deployment was greater and better established in international than in local organisations; probably due to the influence, history and learnings on LSS implementation from their parent companies. These organisations rate well in the success factors relating to the current status of their LSS initiatives as they have established levels of training and coaching, they have adequate numbers of LSS belts holders, high levels of LSS awareness, and they understand

the value of organisational learning and open culture. However, the main challenge faced in Saudi Arabia was changing organisational culture and changing peoples' mind-set.

### 5.2. Local organisations

Local organisations were by far the dominant group in the study. In this group some stand-alone organisations struggled more with LSS implementation than the organisations participating of joint ventures with leading multinational organisations, such as Shell and Caterpillar. The main challenges faced by this group of organisations related to training, leadership, the application of the advanced tools and techniques—as a result of lack of awareness about LSS—and to the lack of top management support and commitment. Contrastingly, the private organisations with joint ventures were better prepared for LSS implementation since their international counterparts provided training material, coaches, certification opportunities, support on process implementation, etc. These international organisations also send a committee (consisting of LSS champions and practitioners) to check and evaluate the implementation process from time to time and request monthly update reports on the status of current LSS projects.

### 5.3. Public and Private organisations

Counterintuitively, very few differences were observed between public and private organisations in terms of Lean and/or Six Sigma adoption. Both sectors have reported similar challenges related to the levels of awareness of LSS, resistance to change and lack of leadership. Yet, the private sector enforces the CI improvement initiatives much harder than public sector; which is evident in the number of years since the introduction of LSS, the number of trained people for LSS, the average times for project completion, etc.

It is of value to shed the light on a particular example of a public organisation, a university that has successfully adopted LSS since its establishment 5 years ago. This university counts with circa 230 GBs and 200 YB and at least 350 members of staff have attended LSS awareness session. Even though according to the literature their number of BBs is still insufficient—counting only with 7 BBs when ideally there should be 20 BBs—the university has successfully carried out LSS projects in diverse business processes including administration, finance, IT, procurement, and library management.

In general and from the results above, it could be said the current status of LSS implementation in Saudi Arabian organisations is behind when compared to western organisations. Yet, it is clear that the awareness about LSS is increasing in the country. Saudi organisations will need years to gain the necessary knowledge, training and experience to achieve the same levels of successful implementation observed in the western organisations.

## 6. Conclusion and Agenda for Future Research

The purpose of this study was to assess the current status of Lean Six Sigma deployment in Saudi Arabian organisations. A survey was undertaken to collect data for Lean and Six Sigma implementation from different sources, such as practitioners, middle managers and CEOs, in organisations that had implemented Lean and / or Six Sigma for at least a year. The results

show that there are still diverse of areas of improvement to be addressed before Saudi organisations can yield the all the expected benefits from LSS implementation. As a starting point, more focus is needed in resolving the issues on training, customers’ needs, project selection and execution, investment, calculating the financial benefits, cultural changes, and effective leadership. Furthermore, improved communication between business units, employees and management, as well as the integration the Six Sigma team to all departments, would aid the understanding and implementation of LSS initiatives.

This study could prove valuable to researchers, practitioners and LSS consultants interested in the application of LSS in the Saudi Arabian context. The information gathered and interpreted provides useful insights on the understanding and implementation of LSS in diverse Saudi Arabian organisations, by comparing the information found in the literature to the reality of Saudi Arabian organisations today. This is done by translating the key success factors, benefits and challenges of LSS implementation as experienced in Western countries to be more relevant and relatable to the challenges faced in Saudi Arabia, especially in terms of organisational learning, organisational culture and the resistance to change.

Yet, this research has certain limitations. It was constrained to Saudi Arabian organisations; therefore, if these insights were to be used generically in other developing countries, validation of the conclusions presented in relation to other countries should be conducted to ensure they are still well-founded in a different context.

Further research will be shaped in the form of interviews in 5 organisations in Saudi Arabia. The interviews will target CEOs, senior managers, quality managers, HR, finance, and LSS team including Champions, MBBs, BBs and GBs. Following the interviews, an LSS implementation maturity model will be developed to be used by Saudi Arabian organisations. The purpose of the model is to assist and support those organisations in measuring their LSS deployment levels and in the identification of gaps for future improvement.

**Acknowledgment**

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## Figures

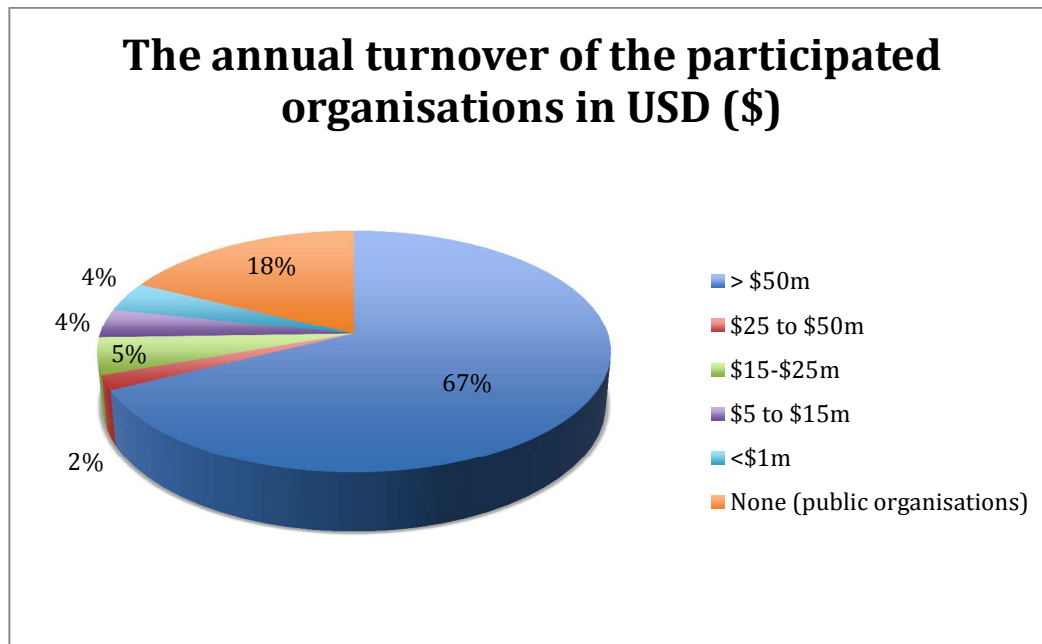


Figure 1: The annual turnover of the participated organisations in USD (\$)

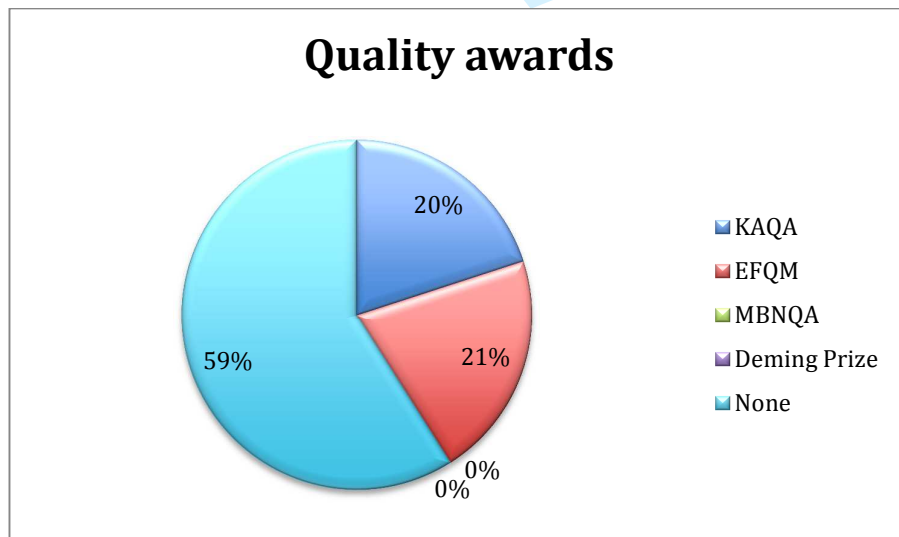


Figure 2: Quality awards

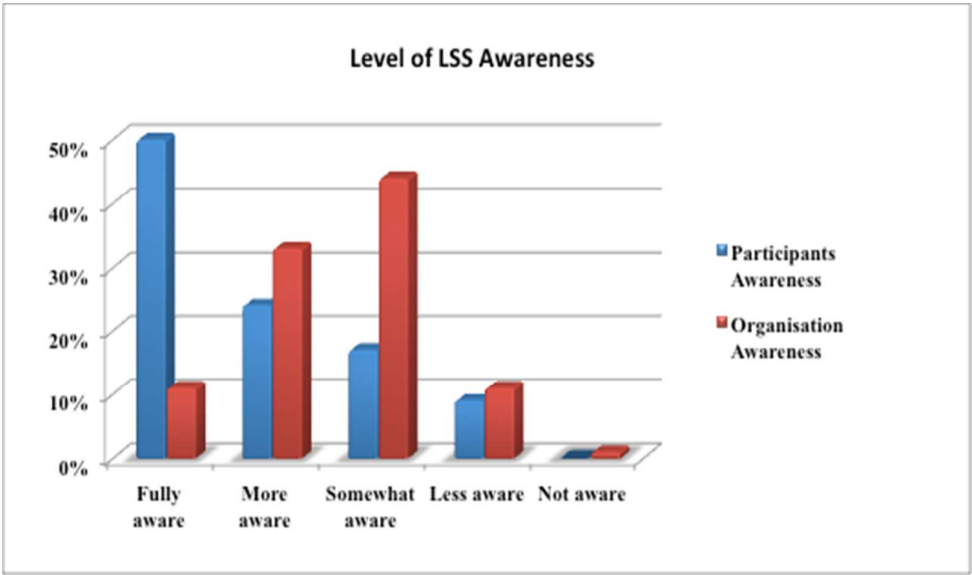


Figure 3: Comparing participants and organisations awareness about LSS

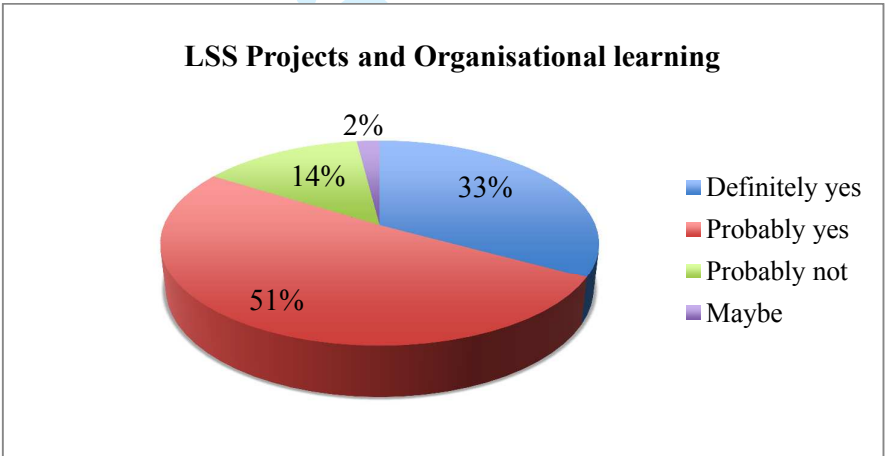


Figure 4:Lean Six Sigma Projects and Organisational learning

## Tables

Table1: Review for LSS publication in different sectors in Saudi Arabia

Sector	Number of Studies	Reference
Healthcare	3	El Faiomy and Shabana, 2012; Al Owad et al., 2013; Reddy and Al Shammari, 2013
Construction	2	Banawi and Bilec, 2014; Kim et al., 2012
Transportation (Airport)	1	Almuharib, 2014
Oil, gas and petrochemicals industry	4	Bubshait and Al-Dosary, 2014; Amminudin et al., 2011; Al-Sadat and Robertson, 2007; Dhafer, 2014
Media and entertainment industry	1	Alharthi et al., 2014
Total number of studies	11	

Table 2: Participant positions

Positions	Number
CEO/ Director/ GM	10
Departmental head	17
Quality manager	8
Assistant manager	8
Team leader	17
Supervisor	8
Staff	25
Other (confidential)	9
Total	102

Table 3: History of CI Methodologies

Continuous improvement methodology	Percentage	Sector
Kaizen, Lean, Six Sigma and TQM	26%	Private
Lean, Six Sigma and TQM	13%	Private
Six Sigma and TQM	9%	Private (3%) and Public (6%)
Lean Six Sigma	22%	Private (8%) and Public (14%)
Kaizen, Lean and Six Sigma	4%	Private (2%) and Public (2%)
Kaizen, Six Sigma and TQM	2%	Private
Kaizen, Lean and TQM	8%	Private (6%) and Public (2%)
Kaizen and Six Sigma	2%	Private
Lean and TQM	2%	Private
Six Sigma	12%	Public



Table 4: Business Process improvement methodology

Business Process improvement methodology	Percentage	Sector
BPM, BPR and TOC	14%	Private
BPM and BPR	25%	Private
BPM and TOC	2%	Private
BPM	39%	Private (23%) and Public (16%)
BPR	7%	Private
TOC	3%	Public
None	10%	Private (4%) and Public (6%)

Table 5: Quality System/Environmental Management System

Quality System/Environmental Management System	Percentage	Sector
ISO 9001	32%	Private and Public
ISO 9001 and ISO 14001	15%	Private and Public
ISO 9001, ISO 14001 and ISO 13053	18%	Private
ISO 9001 and OHSAS 18001	10%	Private
ISO 9001, ISO 14001 and OHSAS 18001	8%	Private
ISO 14001	2%	Private
None	15%	Public

Table 6: Comparing the top 5 benefits

Saudi organisations	Literature
1. Increased customer satisfaction	1. Increased profits and financial savings
2. Reduced cycle time	2. Increased customer satisfaction
3. Improve product and process quality	3. Reduced cost
4. Reduced cost of quality (defects, scrap, rework, repair, etc.)	4. Reduced cycle time
5. Reduce waste in the process	5. Improved key performance metrics

Table 7: Comparing the top 5 Motivational Factors

Saudi organisations	Literature
1. To reduce time (cycle time, lead time, etc.)	1. To improve product quality and manufacturing operations
2. To improve product and process quality	2. To increase customer satisfaction, attraction and loyalty
3. To improve process efficiency and effectiveness	3. To change the competitive position in the market or to stay in the competition in the international market
4. To reduce defects in all business process	4. To increase the bottom line
5. To reduce the cost of quality (cost of	

poor quality, production cost, and so on)	5. To reduce the cost of quality (cost of poor quality, production cost, and so on)
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Table 8: Comparing the top 5 CSFs

Saudi Organisations	Literature
1. Training and coaching	1. Training and coaching
2. Top management commitment and involvement	2. Communication
3. Availability of resources	3. Top management commitment and involvement
4. Communication	4. Organisational culture
5. Project selection and prioritization	5. Project selection and prioritization

Table 9: Comparing the top 5 challenges

Saudi organisations	Literature
1. Time-consuming	1. Time-consuming
2. Lack of leadership	2. Lack of resources
3. Lack of awareness of LSS benefits to the business	3. Unmanaged expectations
4. Convincing top management	4. Lack of awareness about LSS benefits in business
5. Internal resistance	5. Lack of training or coaching

Table 10: Comparing the top 5 tools and techniques

Saudi Organisations	Literature
1. Root Cause Analysis	1. Cause and Effect analysis
2. Brainstorming	2. Value stream mapping
3. SIPOC (Supplier-Input-Process-Output-Customer)	3. 5S Practice
4. Process mapping	4. Design of Experiments (DOE)
5. Value stream mapping	5. Pareto analysis